

Claims

- [c1] 1. A method for implementing pre-heat treatment before spray forming begins to achieve stress control in the manufacture of a spray formed metallic article, comprising:
- preheating at least one of a spray forming cell environment and a mold substrate disposed within the spray forming cell environment to a preselected initial temperature;
- initiating application of a metallic spray forming material at a preselected initial application temperature of the spray-forming material upon the mold substrate in the manufacture of a spray formed article;
- causing preselected substantially homogenous initial metallic phase transformations of the spray forming material from an austenite phase of the spray forming material to a substantially homogenous initial distribution of commingled metallic phases consisting of a predetermined proportion of at least one of a bainite phase and a martinsite phase of the spray forming material and a predetermined proportion of the austenite phase of the spray forming material; and
- wherein the substantially homogenous initial metallic phase transformations are caused at least in part via a predetermined relationship between the initial application temperature of the spray-forming material and the initial temperature of the at least one of the preheated cell environment and the preheated mold substrate.
- [c2] 2. The method of claim 1, wherein causing the initial metallic phase transformations further comprises causing substantially homogenous initial volumetric changes in the spray forming material associated at least in part with the initial metallic phase transformations of the spray forming material.
- [c3] 3. The method of claim 2, wherein causing the initial metallic phase transformations further comprises causing the initial metallic phase transformations to the substantially homogenous initial distribution of commingled metallic phases consisting at least in part of predetermined proportions of both bainite and martinsite phases of the spray forming material and the predetermined proportion of the austenite phase of the spray forming

material.

- [c4] 4. The method of claim 3, wherein causing the initial metallic phase transformations further comprises causing the initial metallic phase transformations to the substantially homogenous initial distribution of commingled metallic phases consisting at least in part of predetermined proportions of bainite, martensite, and pearlite-ferrite phases of the spray forming material and the predetermined proportion of the austenite phase of the spray forming material.
- [c5] 5. The method of claim 1, wherein preheating at least one of the spray forming cell environment and the mold substrate further comprises preheating at least one of the spray forming cell environment and the mold substrate to the initial temperature that is at least as great as the initial application temperature of the spray-forming material.
- [c6] 6. The method of claim 5, wherein preheating at least one of the spray forming cell environment and the mold substrate further comprises preheating at least one of the spray forming cell environment and the mold substrate to the initial temperature that is greater than the initial application temperature of the spray-forming material.
- [c7] 7. The method of claim 5, wherein preheating at least one of the spray forming cell environment and the mold substrate further comprises preheating both the spray forming cell environment and the mold substrate to the initial temperature that is at least as great as the initial application temperature of the spray-forming material.
- [c8] 8. The method of claim 7, wherein preheating both the spray forming cell environment and the mold substrate further comprises preheating both the spray forming cell environment and the mold substrate to the initial temperature that is greater than the initial application temperature of the spray-forming material.
- [c9] 9. The method of claim 5, wherein preheating at least one of the spray forming cell environment and the mold substrate further comprises preheating the spray

forming cell environment to the initial temperature that is at least as great as the initial application temperature of the spray-forming material.

[c10] 10. The method of claim 9, wherein preheating the spray forming cell environment further comprises preheating the spray forming cell environment to the initial temperature that is greater than the initial application temperature of the spray-forming material.

[c11] 11. The method of claim 5, wherein preheating at least one of the spray forming cell environment and the mold substrate further comprises preheating the mold substrate to the initial temperature that is at least as great as the initial application temperature of the spray-forming material.

[c12] 12. The method of claim 11, wherein preheating the mold substrate further comprises preheating the mold substrate to the initial temperature that is greater than the initial application temperature of the spray-forming material.

[c13] 13. The method of claim 1, wherein preheating at least one of the spray forming cell environment and the mold substrate further comprises preheating at least one of the spray forming cell environment and the mold substrate to the initial temperature that is less than the initial application temperature of the spray-forming material.

[c14] 14. The method of claim 13, wherein preheating at least one of the spray forming cell environment and the mold substrate further comprises preheating at least one of the spray forming cell environment and the mold substrate to the initial temperature that is less than the initial application temperature of the spray forming material and greater than a martinsite start temperature of the spray forming material.

[c15] 15. The method of claim 13, wherein preheating at least one of the spray forming cell environment and the mold substrate further comprises preheating at least one of the spray forming cell environment and the mold substrate to the initial temperature that is less than the initial application temperature of the spray forming material and less than a martinsite start temperature of the spray forming material.

[c16] 16. The method of claim 13, wherein preheating at least one of the spray forming cell environment and the mold substrate further comprises preheating both the spray forming cell environment and the mold substrate to the initial cell temperature less than the initial application temperature of the spray-forming material.

[c17] 17. The method of claim 16, wherein preheating both the spray forming cell environment and the mold substrate further comprises preheating both the spray forming cell environment and the mold substrate to the initial temperature that is less than the initial application temperature of the spray-forming material and greater than a martinsite start temperature of the spray forming material.

[c18] 18. The method of claim 16, wherein preheating both the spray forming cell environment and the mold substrate further comprises preheating both the spray forming cell environment and the mold substrate to the initial temperature that is less than the initial application temperature of the spray-forming material and less than a martinsite start temperature of the spray forming material.

[c19] 19. The method of claim 1, wherein preheating at least one of the spray forming cell environment and the mold substrate further comprises preheating the spray forming cell environment to the initial cell temperature that is less than the initial application temperature of the spray-forming material.

[c20] 20. The method of claim 19, wherein preheating the spray forming cell environment further comprises preheating the spray forming cell environment to the initial temperature that is less than the initial application temperature of the spray-forming material and greater than a martinsite start temperature of the spray forming material.

[c21] 21. The method of claim 19, wherein preheating the spray forming cell environment further comprises preheating the spray forming cell environment to the initial temperature that is less than the initial application temperature of the spray-forming material and less than a martinsite start temperature of the

spray forming material.

[c22] 22. The method of claim 1, wherein preheating at least one of the spray forming cell environment and the mold substrate further comprises preheating the mold substrate to the initial cell temperature that is less than the initial application temperature of the spray-forming material.

[c23] 23. The method of claim 22, wherein preheating the mold substrate further comprises preheating the mold substrate to the initial temperature that is less than the initial application temperature of the spray-forming material and greater than a martinsite start temperature of the spray forming material.

[c24] 24. The method of claim 22, wherein preheating the mold substrate further comprises preheating the mold substrate to the initial temperature that is less than the initial application temperature of the spray-forming material and less than martinsite start temperature of the spray forming material.

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